CLAIMS

What is claimed is:

1. A sensor for measuring chloride ion concentration in a medium, comprising:
a pair of electrodes; and
a polymer film imprinted for uptake of chloride ions under alkaline conditions,
wherein the film is disposed on an electrode of the pair of electrodes for contact with the medium.

2. The sensor as recited in Claim 1, wherein the alkaline conditions include a pH range above 7 in the medium.

3. The sensor as recited in Claim 1, wherein the alkaline conditions include a pH range from about 10 to about 12.65 in the medium.

4. The sensor as recited in Claim 1, wherein the film comprises methylpyrrole.

5. The sensor as recited in Claim 1, wherein the film is disposed in contact with the pair of electrodes.

6. The sensor as recited in Claim 5, further comprising:
a source of electric current to a circuit including the pair of electrodes; and
a voltmeter to determine a voltage difference between the pair of electrodes in response to the electric current.

7. The sensor as recited in Claim 5, wherein the film is further disposed to lie between the medium and the pair of electrodes.

8. The sensor as recited in Claim 5, wherein an electrical conductivity of the film depends on an amount of chloride ions taken up by the film.

9. The sensor as recited in Claim 5, wherein the film comprises polypyrrole and polystyrene sulfonate.

10. The sensor as recited in Claim 5, wherein the film comprises poly-methylpyrrole.

11. The sensor as recited in Claim 5, wherein the pair of electrodes comprises gold electrodes.

12. The sensor as recited in Claim 5, wherein the pair of electrodes comprises a pair of interdigitated electrodes.

13. A sensor for measuring chloride ion concentration in a medium, comprising:
a pair of electrodes; and
a conductive polymer film imprinted for uptake of chloride ions,
wherein
the film is disposed in contact with the pair of electrodes,
the film is disposed for contact with the medium, and
an electrical conductivity of the film depends on an amount of chloride ions taken up by the film.

14. The sensor as recited in Claim 13, wherein a measurable change in electrical conductivity occurs for a chloride ion concentration change of less than 0.02 percent by weight in a chloride ion concentration range from about 0.01 percent by weight to about 0.05 percent by weight.

15. The sensor as recited in Claim 13, wherein a measurable change in electrical conductivity occurs for a chloride ion concentration change of less than 0.01 percent by weight in a chloride ion concentration range from about 0.02 percent by weight to about 0.04 percent by weight.

16. The sensor as recited in Claim 13, wherein a minimum detectable chloride ion concentration is about 0.00013 percent by weight.

17. A sensor for measuring chloride ion concentration in a medium, comprising:
a pair of electrodes; and
a conductive polymer film imprinted for uptake of chloride ions under alkaline conditions,
wherein
the film is disposed in contact with the pair of electrodes,
the film is disposed for contact with the medium, and
an electrical conductivity of the film depends on an amount of chloride ions taken up by the film.

18. The sensor as recited in Claim 17, wherein a measurable change in electrical conductivity occurs for a chloride ion concentration change of less than 0.02 percent by weight in a chloride ion concentration range from about 0.01 percent by weight to about 0.05 percent by weight.

19. The sensor as recited in Claim 17, wherein a measurable change in electrical conductivity occurs for a chloride ion concentration change of less than 0.01 percent by weight in a chloride ion concentration range from about 0.02 percent by weight to about 0.04 percent by weight.

20. The sensor as recited in Claim 17, wherein a measurable change in electrical conductivity occurs for a chloride ion concentration change of less than 0.02 percent by weight in a chloride ion concentration range above about 0.02 percent by weight in a medium with a pH up to at least 12.65.

21. An apparatus for long term monitoring of chloride ion concentration in a medium, comprising:

a sensor platform for embedding in a medium;

a transmitter disposed on the sensor platform for transmitting to an interrogation unit a response signal based on a chloride measurement; and

a chloride sensor disposed on the sensor platform, which chloride sensor generates the chloride measurement, said chloride sensor comprising

a pair of electrodes, and

a conductive polymer film imprinted for uptake of chloride ions under alkaline conditions,

wherein

the film is disposed in contact with the pair of electrodes,

the film is disposed for contact with the medium, and

an electrical conductivity of the film depends on an amount of chloride ions taken up by the film.

22. The apparatus as recited in Claim 21, wherein.

the apparatus further comprises a power module disposed on the platform, which power module is powered by an interrogation pulse transmitted by the interrogation unit; and

the transmitter and the chloride sensor are powered by the power module.

23. The apparatus as recited in Claim 21, wherein:

the apparatus further comprises a conductivity sensor disposed on the platform for generating an electrical conductivity measurement of the medium; and

the response signal is further based on the conductivity measurement.

24. The apparatus as recited in Claim 23, wherein:
the apparatus further comprises a processor disposed on the sensor platform, which processor derives a moisture-corrected chloride measurement based on the chloride measurement and the conductivity measurement; and
the response signal is based on the moisture-corrected chloride measurement.

25. A method for fabricating a sensor for measuring chloride ion concentration in a medium, the method comprising the steps of:
depositing an electrode on a substrate;
after said step of depositing the electrode, placing the substrate in an electrolyte solution of lithium chloride and methylpyrrole;
after said step of placing the substrate in the electrolyte solution, applying cyclic voltammetry to form a polymer film in contact with the electrode.

26. The method as recited in Claim 25, wherein.
said step of depositing the electrode on the substrate further comprises depositing a pair of electrodes on the substrate;
the method further comprising, before said step of placing the substrate in the electrolyte solution, performing the step of treating the substrate with a silanizing agent to enhance adherence of a pyrrole species to the substrate between the pair of electrodes.

27. The method as recited in Claim 26, said step of treating the substrate with a silanizing agent further comprising treating the substrate with a silanizing agent that comprises silica and pyrrole.

28. The method as recited in Claim 26, said step of depositing the pair of electrodes on the substrate further comprising depositing gold electrodes on the substrate.

29. The method as recited in Claim 26, said step of depositing the pair of electrodes on the substrate further comprising depositing a pair of interdigitated electrodes on the substrate.

30. The method as recited in Claim 25, further comprising, before said step of depositing an electrode on the substrate, performing the step of forming the substrate by depositing silica glass on an alumina ceramic plate.

31. A method for fabricating a sensor for measuring chloride ion concentration in a medium, the method comprising the steps of:

depositing a pair of electrodes on a substrate;

treating the substrate with a silanizing agent to enhance adherence of pyrrole to the substrate between the pair of electrodes;

after said step of treating the substrate with a silanizing agent, placing the substrate in an electrolyte solution of lithium chloride and pyrrole;

after said step of placing the substrate in the electrolyte solution, applying cyclic voltammetry to form a polymer film in contact with the pair of electrodes.